# MESHFREE FORMULATION COUPLED WITH PARTICULAR SOLUTION FOR BOUDARY VALUE PROBLEMS

**J. S. Chen, D. Wang,** and **S. B. Dong**

Department of Civil and Environmental Engineering
5731G Boelter Hall
University of California, Los Angeles
Los Angeles, CA 90095-1593
jschen@seas.ucla.edu

Numerical methods such as finite element and meshfree methods have shown great success in solving boundary value problems. However, when singular or nearly singular source terms appear in the governing equation, these methods are not very effective unless a very fine discretization is used. In this work, we represent the solution of the boundary value problem by the combination of particular and homogeneous solutions. The particular solution is any analytical (or numerical) expression satisfying the governing equation containing the source term but not necessarily the boundary conditions. Thus, the original problem is reduced to the solution of a homogeneous partial differential equation with boundary conditions modified by the particular solution. By this decomposition, the numerical analysis involves only a solution of an auxiliary lower order problem where a relatively coarse discretization is acceptable. In this work, the meshfree method is adopted to determine the homogeneous solution. Several boundary value problems from potential theory as well as the shear deformable plate theory are solved using the proposed coupled particular and meshfree formulation. Linear exactness [1] and bending exactness [2] are imposed in the meshfree approximation of the auxiliary homogeneous potential problem and shear deformable plate problem, respectively. Numerical results demonstrate that the proposed approach significantly improves the solution accuracy compared to the conventional meshfree formulation. It is also shown that improved accuracy is obtained even for the problems where the source terms are not singular or nearly singular.

[1] J. S. Chen, C. T. Wu, S. Yoon, S., and Y. You, "A Stabilized Conforming Nodal Integration for Galerkin Meshfree Methods," *International Journal for Numerical Methods in Engineering*, 50, 435-466.
[2] D. Wang and J. S. Chen, "Locking-free Stabilized Conforming Nodal Integration for Meshfre Mindlin-Reissner Plate Formulation", to appear, special issue on Meshfree Particle Methods, *Computer Methods in Applied Mechanics and Engineering*.